Demand-and-Supply Imbalance Risk and Long-Term Swap Spreads

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Discussed by Urban Jermann

Contribution

- Tractable model for pricing interest rate swaps
  - leverage constraint, demand shocks and convergence risk
- User demand proxied by Primary Dealer net Treasuries position
  - Negative swap spreads since 2008
    - Swap spread changes sign when net position changes sign
    - Time-series correlation
  - After 2008
    - User demand predicts excess returns
    - User demand 50%/35% of innovation variance weekly/annual

Model

Intermediaries $\max_{x_t,o_t} \left\{ E_t\left[w_{t,t+1}\right] - \frac{\alpha}{2} Var_t\left[w_{t,t+1}\right] \right\}$

s.t. budget constraint $w_{t,t+1} = w_t + x_t r^s_{t+1} + o_t r^o_{t+1}$

s.t. leverage constraint $\kappa_x \left|x_t\right| + \kappa_o \left|o_t\right| \leq w_t$

receive-fixed swap spread trade

$r^s_{t+1} \equiv r^S_{t+1} - r^T_{t+1} = \left(s_t - m_t\right) - \frac{\delta}{1-\delta}\left(s_{t+1} - s_t\right)$

$s_t \equiv y^S_t - y^T_t$

$m_t \equiv i^S_t - i^T_t$

End-user swap demand $d_t = \bar{d} + z^d_t + \gamma s_t$

Market clearing $x_t + d_t = 0$

Model characterization

FOC for x_t, impose market clearing $x_t = -d_t$, assuming $corr\left(r^s_{t+1}, r^o_{t+1}\right) = 0$ (LTCM?)

$$\begin{aligned} E_t r^s_{t+1} &= -\alpha V_t d_t - \kappa_x sgn\left(d_t\right)\psi_t \\ &= \left(s_t - m_t\right) - \frac{\delta}{1-\delta}\left(E_t s_{t+1} - s_t\right) \end{aligned}$$

$$s_t = (1-\delta)\left[\underbrace{(-\alpha)\, V_t d_t}_{\text{comp. for risk}} + \underbrace{(-\kappa_x)\, sgn\left(d_t\right)\psi_t}_{\text{comp. for capital}} + \underbrace{m_t}_{\text{short rate diff}}\right] + \delta E_t s_{t+1}$$

If $d_t > 0$ (after 2008) and $E\left(m_t\right) < \bar{m}^*$ then $E\left(s_t\right) < 0$
"End-users receive fixed, dealers pay fixed, compensation lowers fixed rate"

Affine equilibrium

Assume: $d_t > 0$ (after 2008), constraint always binding, shock processes homoscedastic AR(1)

Theorem 1

$$s_t = A_0 + A_m[V]\, z_t^m + A_d[V]\, z_t^d + A_w[V]\, z_t^w$$

and

$$Var_t\left[r_{t+1}^s\right] \equiv V = \left(\frac{\delta}{1-\delta}\right)^2 \left(A_m^2[V]\,\sigma_m^2 + A_d^2[V]\,\sigma_d^2 + A_o^2[V]\,\sigma_o^2\right)$$

Example: Only demand shocks

If $\kappa_x = 0$, $m_t = 0$, $d_t = \bar{d} + z_t^d$, and $z_{t+1}^d = \rho_d z_t^d + \varepsilon_{t+1}$

then

$$s_t = (-\alpha) V\bar{d} + \left(\frac{1-\delta}{1-\delta\rho}\right)(-\alpha) V z_t^d$$

and

$$Var_t\left[r_{t+1}^s\right] \equiv V = \left\{\left(\frac{\delta}{1-\delta\rho}\right)(-\alpha)\right\}^2 \sigma_d^2 V^2$$

2 equilibriums: $V = 0$ and $V = 1/\left\{\left(\frac{\delta}{1-\delta\rho}\right)(-\alpha)\right\}^2 \sigma_d^2 > 0$

Main model predictions brought to the data

Prop 1.

$$E\left(s_t\right) < 0 \text{ if } d_t > 0 \text{ (after 2008) and } E\left(m_t\right) < \bar{m}^*$$

with d_t =Primary Dealer UST Net

Prop 2.

$$E_t\left(r^s_{t+1}\right) = -\kappa_x \psi_t - \alpha V d_t$$

Prop 5.

$$\begin{bmatrix} s_t \\ d_t \end{bmatrix} = \begin{bmatrix} A_0 \\ \bar{d} + \gamma A_0 \end{bmatrix} + \begin{bmatrix} - & + \\ + & + \end{bmatrix} \begin{bmatrix} z^d_t \\ z^w_t \end{bmatrix}$$

Comments/Questions

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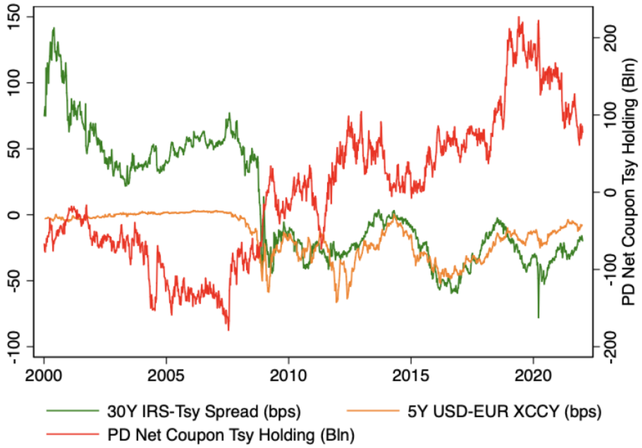
- Exogenous wealth dynamics misses amplification and new entry
- $s_t =$

$$(1-\delta)\left[\underbrace{(-\alpha)\,V_t d_t}_{\text{comp. for risk}} + \underbrace{(-\kappa_x)\,sgn\,(d_t)\,\psi\overbrace{(|x_t| - w_t)}^{+}}_{\text{comp. for capital}} + \underbrace{m_t}_{\text{short rate diff}}\right]$$
$$+\delta E_t s_{t+1}$$

Connection to USD-EUR CIP deviations

Du, Hebert, Li (2022)

Figure 1: Primary Dealer Treasury Holing, Swap Spreads, and Cross-Currency Basis.



Add CIP trade to the model

- Appendix B1: outside investment is riskless arbitrage, a_t

$$r^a_{t+1} = \bar{r}_a - \lambda_a a_t \equiv -CIP \text{ basis}_t$$

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- FOC for a_t

$$\psi_t = \max\left\{0, \frac{-CIP \text{ basis}_t}{\kappa_a sgn\left(a_t\right)}\right\}$$

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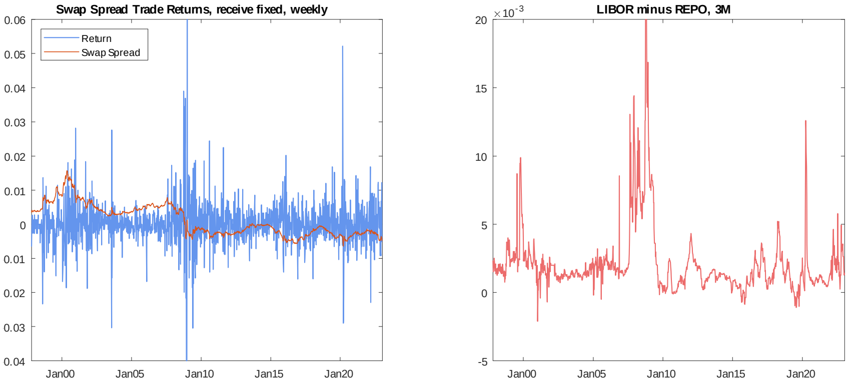
- use for predicting returns

$$E_t \left(r^s_{t+1}\right) = -\kappa_x \psi_t - \alpha V d_t$$

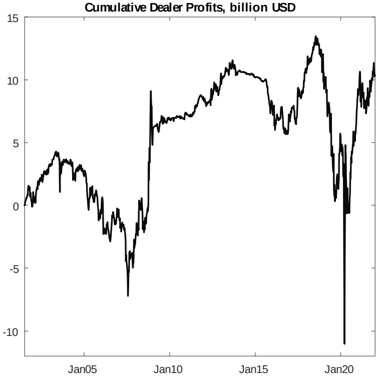
Swap spread trade before and after 2008

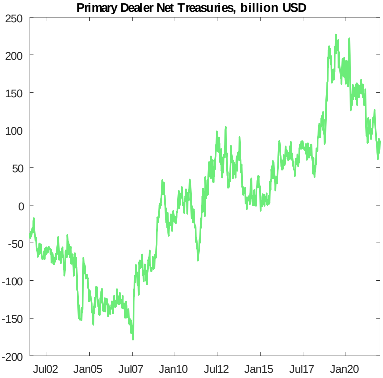
If balance sheet costs were low pre-2008, supply shocks mattered less and returns behaved differently.


Swap Spread Trade Returns, receive fixed, weekly
Return
Swap Spread
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
Jan00
Jan05
Jan10
Jan15
Jan20
LIBOR minus REPO, 3M
×10-3
20
15
10
5
0
-5
Jan00
Jan05
Jan10
Jan15
Jan20

Was swap spread trade profitable for dealers?

(! assuming all swaps have 30 year maturity)





Conclusion

- Insightful paper on important topic!
- Next steps (in this area)
    - Quantitative models
    - Better understanding of dealers' objectives/constraints